



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Application of
ARNOLD, James E.
Serial No. 09/505,803
Filed: February 17, 2000
For: METHOD FOR FORMING
METAL PARTS HAVING
SUPERIOR SURFACE
CHARACTERISTICS

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Group Art Unit - 3726
Examiner: COMPTON, E
Docket No. RAG-021400

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COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

Appeal Brief

S I R:

An appeal has been taken from the Final Rejection of the pending Claims mailed February 21, 2003. A Notice of Appeal and the prescribed fee was included with an Amendment After Final filed June 18, 2003.

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(1) Real party in interest:

The present application has been assigned to Recast Airfoil Group.

(2) Related appeals and interferences:

There are no other appeals or interferences known to appellant, the appellant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of claims:

Claims 17-23 and 25-36 are pending. Claims 1-16 and 24 have been canceled. A Final Rejection was mailed on February 21, 2003. In that Final Rejection, claims 17-23 and 25-36 were rejected under 35 U.S.C. 103(a) as being unpatentable over applicant's admitted prior art in view of US Patent 5,156,321 to Liburdi et al ("Liburdi"). The claims remaining on appeal are claims 17-23 and 25-36

(4) Status of amendments:

An Amendment After Final was filed on June 18, 2003. The Amendment After Final included a request for reconsideration. In an Advisory Action mailed July 7, 2003 the examiner indicated that the request has been considered but does not place the application in condition for allowance.

In the Amendment After Final, claims 17 and 25 were amended to more clearly distinguish the claimed invention from the prior art. The Advisory Action did not indicate if the proposed amendments of the claims submitted with the Amendment After Final are entered or not entered, but indicated that the status of claims 17-23 and 25-36 as being rejected.

(5) Summary of invention:

The present invention pertains to a method of forming a metal product, such a tool bit, snow ski blade or kitchen knife, having an edge area comprising a cutting edge (see, specification at page 58, lines 2-9). The cutting edge is formed, in accordance with the

present invention, having a wear resistant surface with superior sharpening and sharpened edge holding characteristics. In accordance with the present invention, a work piece substrate is provided having an edge area comprising a cutting edge portion. A high-density coating process is used to coat the cutting edge portion of the work piece substrate with a wear resistant coating material. A hot isostatic pressing treatment is performed on the coated work piece substrate to obtain a metal product having a wear resistant surface comprised of the coating material. The wear resistant surface is formed at the cutting edge portion having diffusion bonding between the coating material and the work piece substrate. The diffusion bond overcomes the drawbacks of prior cutting tools by providing a wear resistant and edge holding cutting edge that becomes an integral part of the cutting tool substrate. The cutting edge portion is sharpened so that the diffusion bonding between the coating material and the workpiece substrate retains the wear resistant coating material on the cutting edge portion. In accordance with the present invention, the drawbacks of the prior art are overcome because the wear resistant coating is diffusion bonded and thus retained during the sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product (see, specification page 57, line 12 through page 60, line 3 and Figures 2(a) through 2(d)).

As shown in Figures 2(a) through 2(d), the inventive method can be used for forming, a cutting tool having a wear resistant surface. The inventive method can be employed to produce, for example, a long

lasting cutting tool from a relatively inexpensive cutting tool substrate 10. For example, the tool substrate 10 may be a drill bit, end mill, lathe tool bit, saw blade, planer knives, cutting tool inserts, or other cutting tool part. The substrate may, alternatively, be something other than a tool. For example, ice skate blades and snow ski edges may be treated in accordance with the present invention to obtain a long wearing edge. Kitchen knives may be treated in accordance with the present invention to reduce the need for constant sharpening. Further, products such as pen tips and fishing hooks may be treated in accordance with the present invention so as to benefit from long lasting durability (see, for example, pages 57 - 60 of the present specification).

(6) Issues:

Claims 17-23 and 25-36 were rejected as being unpatentable over Applicant's Admitted Prior Art ("AAPA") in view of US Patent 5,156,321, issued to Liburdi et al ("Liburdi").

An issue presented for review is whether it would have been obvious to modify the AAPA in view of the teachings of Liburdi without the improper hindsight provided by the claimed invention.

Another issue presented for review is whether there is any motivation provided by Liburdi to modify the conventional method of producing a conventional cutting tool so that a diffusion bonded

hard coating is created at the cutting tool's edge area to overcome the problems that typically cause a conventional cutting tool to lose its sharpened edge.

Another issue presented for review is whether there is any motivation provided by Liburdi to modify the conventional method of producing a kitchen knife so that a diffusion bonded wear resistant coating is created at the cutting edge of the kitchen knife.

(7) Grouping of claims:

The claims do not stand or fall together.

Group One:

Independent claim 17, dependent claims 18-23, 25, 26; and
Independent claim 32 and dependent claims 33-36

The claims of group one are directed to a method of forming a cutting tool having a cutting edge having a wear resistant surface.

Group Two:

Independent claim 27 and dependent claims 28-31.

The claims of group two are directed to a method of forming a kitchen knife having a cutting edge having a wear resistant surface.

(8) Argument:

The claims do not stand or fall together

The claims of group one are directed to a method of forming a metal product having a cutting edge having a wear resistant surface. The claims of group two are directed to a method of forming a kitchen knife having a cutting edge having a wear resistant surface.

Applicant respectfully submits that the claims of group one and group two are separately patentable. Both group one and group two pertains to methods of making cutting tools having superior cutting edge characteristics. However, group two is directed to a kitchen knife, which is a specific type of cutting tool. It is well settled that a new use can be patentable. Accordingly, even if it is found that the claimed method for forming a cutting tool having superior cutting edge characteristics is not patentable over the prior art, a method of forming a kitchen knife may still be patentable as a new use.

Errors in the rejection of the claims based on obviousness:

The claims have been rejected as being obvious based on the combination of AAPA and Liburdi. As correctly noted by the examiner in the Advisory Action, Liburdi was also discussed by AAPA (specification, page 10, line 1).

In relevant part, AAPA discusses references (including Liburdi) that show that a hot isostatic pressing treatment can be used in repairing gas turbine engine airfoil parts to form a diffusion boundary between a coating and a substrate. The AAPA also discusses in

relevant part the conventional methods and structures of cutting tools which have either wear resistant materials applied by mechanically bonded coatings or brazed cutting tips. The AAPA specifically note the drawbacks of the conventional cutting tools which fail due to wear resistant materials being removed during use of the cutting tool. Specifically, the AAPA points out that the mechanically bonded coatings flake or chip due to failure at the mechanical bond interface between the coating and the cutting tool substrate, or the brazed cutting tips break off during use due to the relatively brittle brazed interface between the cutting tool substrate and the cutting tip.

Improper hindsight applied in rejecting claims:

An issue presented for review is whether it would have been obvious to modify the AAPA in view of the teachings of Liburdi without the improper hindsight provided by the claimed invention.

"To imbue one of ordinary skill in the art with knowledge of the invention in suit, when no prior art reference or references of record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher." W.L. Gore & Assocs., Inc. v. Garlock, Inc., 721 F.2d 1540, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983).

Obviousness cannot be established by hindsight combination to produce the claimed invention. In re Gorman, 933 F.2d 982, 986, 18 USPQ2d 1885, 1888 (Fed.Cir.1991).

It is the prior art itself, and not the applicant's achievement, that must establish the obviousness of the combination. The AAPA indicates examples of the current state of the art where mechanically bonded coating and brazed tips are being used to improve the wear resistance of the cutting edge. Metal cutting tools go far back in history, and throughout history advancements have been made to improve the wear resistance of the cutting edge. However, even with such a long lineage of technological development, there are no references related to cutting tools, such as drill bits and kitchen knives, that even remotely suggest the method steps of applicant's invention for creating a superior wear resistance cutting edge. Applicant has recognized that forming a diffusion bond between a wear resistant coating will result in a cutting tool, such as a drill bit or kitchen knife, that has a superior cutting edge. To provide a wear resistant surface, and thus increase the service life of a sharpened edge, the AAPA shows that the conventional art either used a mechanically bonded wear resistant coating applied to the tool substrate or a wear resistant cutting tip adhered to the tool substrate. Both of these solutions is less than adequate because during use the mechanically bonded coating chips or flakes off and the wear resistant cutting tip breaks off. Applicant's invention is to use a high density coating and HIP treatment to overcome the problems of the conventional cutting tools.

Applicant's invention is to form a high density, wear resistant coating on a tool substrate and create a diffusion bond between the tool substrate and the coating through the HIP process. This invention obtains a cutting tool that is superior to the conventional cutting tools and an important advancement in the art of cutting tools.

No where in any of the AAPA, or the other references of record, is there a recognition that the cutting edge of a cutting tool can be improved through the application of a high density coating and a diffusion bond created through the HIP process. Applicant recognized this advantage and invented the method defined by the claims through this recognition. It is not proper to apply Applicant's own invention, the combination of a cutting tool with a diffusion bonded wear resistant cutting edge, in making the obviousness rejection. To do so would be using Applicant's own invention against him.

The AAPA that discuss using a HIP process to form a diffusion bond do not form this bond to create a superior wear resistant coating on the sharpened edge of a cutting tool, such as a drill bit or kitchen knife. Rather, these references use HIP to repair gas turbine engine parts.

Likewise, the AAPA that discuss the drawbacks of the conventional cutting tools do not recognize that a solution to the drawbacks can be obtained through the HIP process. The combination of a cutting tool substrate with a HIP processed diffusion bonded wear resistant coating is the very essence of applicant's own invention. There is no reference that suggests improving a cutting tool using a metalurgical process that is known for repairing gas turbine engine parts. Applicant respectfully submits that the hindsight afforded by the applicant's invention has been used in rejecting the claims based on obviousness and the rejection should be removed.

Lack of motivation:

Another issue presented for review is whether there is any motivation provided by Liburdi to modify the conventional method of producing a conventional cutting tool so that a diffusion bonded hard coating is created at the cutting tool's edge area to overcome the problems that typically cause a conventional cutting tool to loose its sharpened edge.

The examiner contends that the HIP treatment discussed in AAPA (including Liburdi) would motivate one of ordinary skill in the art to modify the conventional methods for forming cutting tools, such as drill bits and kitchen knives, and thereby render obvious the formation of a superior cutting tool with a diffusion bonded wear resistant coating. (see, the Advisory Action pages 2 and 3).

It is well settled that even if a combination of references teaches every element of a claimed invention, without a motivation to combine, a rejection based on obviousness is improper. (see, *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998)).

The AAPA related to cutting tools teaches that a mechanically adhered coating can be applied to a cutting tool to improve the wearability of the tool's cutting edge. This is the recognition of the drawbacks of the conventional art for which Applicant's invention is a solution. This AAPA is provided in the specification as background for showing that the conventional techniques for creating wear resistant surfaces on cutting tools are known to have problems that need to be improved. Applicant's invention is the improvement that solves these problems. The AAPA related to HIP treatment teaches that a HIP process can be used to form a diffusion boundary between a coating and a substrate. These references show that HIP can be used to repair objects, such as cracks in gas turbine engine parts. But, there is no motivation in the AAPA related to the cutting tools or the AAPA related to the HIP process to combine the HIP process with the coated cutting tool to obtain a superior cutting edge as defined by the claimed invention. The diffusion bonding created by the HIP process for repairing a gas turbine engine blade may be similar or even the same as the diffusion bonding created by the HIP process for making a superior cutting edge of a cutting tool such as a knife or drill bit. The step for creating this diffusion bond

may also be the same. However, the method that employs this step in the claimed invention results in the creation of a cutting tool having a superior cutting edge.

There is no recognition or suggestion in the HIP related AAPA to the problems associated with the failure of conventional cutting tools. Nor is there any recognition or suggestion in the cutting tool related AAPA to the creation of a diffusion bond for overcoming the problem of flaking or removal of the wear resistant cutting material – this is the very problem that is solved by the claimed invention. The problem is solved by the inventive use of the high density coating/HIP treatment process. There is no suggestion and no motivation provided in the references for forming a cutting tool using these processes.

The Examiner states that it is well known to form a sharpened edge using a grinding process. The Examiner further states that although Liburdi does not specifically disclose a cutting edge for a cutting tool, this reference does disclose that the outer edge of a turbine blade is subjected to a grinding process (see, Advisory Action, page 3 and 4). The blade tip of a turbine engine blade is provided to prevent gas from escaping between the engine blade and the blade assembly housing. It is clearly not the cutting edge of a cutting tool. As correctly pointed out by the Examiner, Liburdi does not teach the formation of a cutting edge for a cutting tool. The blade tip is ground to restore it to its original shape (Liburdi, Col. 6, lines 55-57). Applicant's claimed invention requires the step of "sharpening

the cutting edge portion so that the diffusion bonding between the coating material and the workpiece substrate retains the wear resistant coating material on the cutting edge portion during the sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product. (see, for example, claim 17). Liburdi mentions that the blade tip is ground to restore the original shape, which is necessary create a seal between the blade tip and the blade housing. However, the as shown, for example in Figures 1(a) – 1(f), and discussed at Col. 2, line 50 through Col 3, line 17 (and throughout the Liburdi reference)), Liburdi teaches that a crack can be repaired or two pieces of metal joined using the techniques taught by this reference. There is suggestion or motivation to forming a wear resistant coating at an edge area, and particularly no suggestion or motivation to for a diffusion bonded wear resistant coating at a cutting edge. Applicant respectfully submits that just because Liburdi mentions that the blade tip can be ground to reshape it, this reference does not provide the proper motivation to modify the AAPA related to cutting tools, without the improper hindsight provided by applicant's own invention.

The AAPA teaches that it is known to apply a wear resistant coating to a conventional cutting tool to obtain a wear resistant cutting edged. For example, the AAPA discusses that it is known to form a wear resistant coating of Cobalt on a cutting tool substrate through chemical vapor deposition (specification, page 4, line 17 through page 5 line 1). The AAPA relevant to this teaching also discusses

that “the bond between the substrate and the coating occurs primarily through mechanical adhesion within a narrow bonding interface. During use, the coating at the cutting surface of the cutting tool is subjected to shearing forces resulting in flaking of the coating off the tool substrate. The failure is likely to occur at the narrow bonding interface” (specification, page 5, lines 1-5).

The specific limitations in the rejected claims are not described in the prior art relied on in the rejection. Applicant’s invention, as defined by the claims, solves this failure by providing a method of forming a metal product having an edge area comprising a cutting edge having a wear resistant surface. A high-density coating process is performed to coat the cutting edge portion of the workpiece substrate with a wear resistant coating material. A hot isostatic pressing treatment is performed on the coated workpiece substrate to obtain a metal product having a wear resistant surface comprised of the coating material. The wear resistant surface is formed at the cutting edge portion and has diffusion bonding between the coating material and the workpiece substrate. The cutting edge portion is sharpened so that the diffusion bonding between the coating material and the workpiece substrate retains the wear resistant coating material on the cutting edge portion during the sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product. Applicant respectfully submits that these claim limitations render the claimed subject matter unobvious over the prior art.

No motivation to modify a kitchen knife:

Another issue presented for review is whether there is any motivation provided by Liburdi to modify the conventional method of producing a kitchen knife so that a diffusion bonded wear resistant coating is created at the cutting edge of the kitchen knife.

The AAPA relating to forming a diffusion bond (including Liburdi) and the AAPA relating to conventional cutting tools, taken as a whole, do not suggest the claimed subject matter. The AAPA related to cutting tools merely points out the very deficiencies of the conventional cutting tool art that are overcome by the claimed invention. A kitchen knife is a specific cutting tool that is improved by the claimed method. The cutting edge of a conventional kitchen knife must be constantly sharpened and honed to keep it as useful a tool for food preparation as possible. In accordance with the claimed invention, a kitchen knife is improved by providing a superior cutting edge that retains its sharpened state. In accordance with the claimed invention, a diffusion bond is formed between the wear resistant coating the knife substrate. The AAPA, including Liburdi, related to the HIP process teaches that a HIP process can be used to form a diffusion coating between a substrate and the coating material. However, the AAPA does not recognize or provide any motivation creating the diffusion boundary to make a kitchen knife with a cutting edge that lasts longer. The AAPA, including Liburdi, related to the HIP process, are all directed to the repair of cast metal objects, such as gas turbine engine parts. These references show examples of the HIP process but do not provide any examples where

HIP is used to overcome the problem of a mechanically adhered wear resistant coating on the cutting edge of a kitchen knife. There is no recognition in any of the prior art to the superior cutting edge that can be obtained by forming a diffusion bonded wear resistant coating on the cutting edge of a knife.

The HIP method disclosed in AAPA (including Liburdi) may not properly be combined with AAPA relating to the conventional kitchen knives. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." *In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). See also >*In re Lee*, 277 F.3d 1338, 1342-44, 61 USPQ2d 1430, 1433-34 (Fed. Cir. 2002)

Knives are ancient cutting tools with a long history of technological improvements. Yet, there is no reference that suggests the desirability of forming a diffusion bonded wear resistant cutting edge on the knife. There is no reference that recognizes the advantage of forming a wear resistant coating at the cutting edge that will not flake off or chip. There is no reference that suggests

any motivation for looking to a method of repairing a gas turbine engine part, such as Liburdi, to provide a means for improving the cutting edge of a kitchen knife. Accordingly, applicant respectfully submits that the claimed invention is patentably distinct from the prior art.

Respectfully submitted,

September 17, 2003

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MAILING CERTIFICATE

Date of Deposit: September 17, 2003

I hereby certify that this correspondence is being deposited with the United States Postal Service as "First Class Mail" on the date indicated above in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

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Appendix: claims involved in the appeal

17) A method of forming a metal product having an edge area comprising a cutting edge having a wear resistant surface, comprising the steps of: forming a workpiece substrate having an edge area comprising a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the workpiece substrate with a wear resistant coating material; performing a hot isostatic pressing treatment on the coated workpiece substrate to obtain a metal product having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the workpiece substrate; and sharpening the cutting edge portion so that the diffusion bonding between the coating material and the workpiece substrate retains the wear resistant coating material on the cutting edge portion during the sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product.

18) A method of forming a metal product having a cutting edge according to claim 17; wherein the step of performing the high-density coating process comprises performing a hyper velocity oxy-fuel thermal spray process.

19) A method of forming a metal product having a cutting edge according to claim 18; wherein the step of hot isostatic pressing treating comprises the step of heating the coated cutting tool substrate to a temperature that is substantially 80% of the melting point of the coating material; and pressurizing the coated cutting tool substrate to a pressure substantially between 20 and 50 percent of the yield strength of the [metal alloy] coating material in an inert gas atmosphere.

20) A method of forming a metal product having a cutting edge according to claim 19; further comprising the step of performing a sintering heat treatment on the coated workpiece substrate to remove entrapped gas in the coating material before performing the hot isostatic pressing treatment so that the formed metal product has a relatively smooth surface texture.

21) A method of forming a metal product having a cutting edge according to claim 17; wherein the workpiece substrate comprises a high speed steel substrate composition.

22) A method of forming a metal product having a cutting edge according to claim 17; wherein the coating material comprises a hard and durable metal such as Cobalt, Carbide and TiN.

23) A method of forming a metal product having a cutting edge according to claim 17; wherein the workpiece substrate comprises a nickel or cobalt-base superalloy; and the step of performing the high-density coating process comprises performing a high-density coating process such as a hyper velocity oxy-fuel thermal spray process or a detonation gun process to apply the coating material as a high-density coating.

25) A method of forming a metal product having a cutting edge according to claim 17, wherein the cutting tool comprises one of a drill bit, end mill, lathe tool bit, saw blade, planer knife, and cutting tool insert.

26) A method of forming a metal product having a cutting edge according to claim 17; wherein the metal product formed comprises one of an ice skate blade, snow ski edge, pen tip and fishing hook.

27) A method of forming a kitchen knife having an edge area comprising a cutting edge having a wear resistant surface, comprising the steps of: forming a knife substrate having an edge area comprising a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the knife substrate with a wear resistant coating material; performing a hot isostatic pressing treatment on the coated knife substrate to obtain a kitchen knife having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the knife substrate; and sharpening the cutting edge portion so that the diffusion bonding between the coating

material and the knife substrate retains the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed kitchen knife.

28) A method of forming a kitchen knife having a cutting edge according to claim 27; wherein the step of performing the high-density coating process comprises performing a hyper velocity oxy-fuel thermal spray process.

29) A method of forming a kitchen knife having a cutting edge according to claim 28; wherein the step of hot isostatic pressing treating comprises the step of heating the coated cutting tool substrate to a temperature that is substantially 80% of the melting point of the coating material; and pressurizing the coated cutting tool substrate to a pressure substantially between 20 and 50 percent of the yield strength of the coating material in an inert gas atmosphere.

30) A method of forming a kitchen knife having a cutting edge according to claim 29; further comprising the step of performing a sintering heat treatment on the coated knife substrate to remove entrapped gas in the coating material before performing the hot isostatic pressing treatment so that the formed kitchen knife has a relatively smooth surface texture.

31) A method of forming a kitchen knife having a cutting edge according to claim 27; wherein the coating material comprises a hard and durable metal such as Cobalt, Carbide and TiN.

32) A method of forming a cutting tool having a cutting edge having a wear resistant surface, comprising the steps of: forming a cutting tool substrate having a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the cutting tool substrate with a wear resistant coating material; and performing a hot isostatic pressing treatment on the coated cutting tool substrate to obtain a cutting tool having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the cutting tool substrate, the diffusion bonding between the coating material and the cutting tool substrate being effective for retaining the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed cutting tool.

33) A method of forming a cutting tool having a cutting edge according to claim 32; wherein the step of performing the high-density coating process comprises performing a hyper velocity oxy-fuel thermal spray process.

34) A method of forming a cutting tool having a cutting edge according to claim 33; wherein the step of hot isostatic pressing treating comprises the step of heating the coated cutting tool substrate to a temperature that is substantially 80% of the melting point of the coating material; and pressurizing the coated cutting tool substrate to a pressure substantially between 20 and 50 percent of the yield strength of the coating material in an inert gas atmosphere.

35) A method of forming a cutting tool having a cutting edge according to claim 34; further comprising the step of performing a sintering heat treatment on the coated cutting tool substrate to remove entrapped gas in the coating material before performing the hot isostatic pressing treatment so that the formed cutting tool has a relatively smooth surface texture.

36) A method of forming a cutting tool having a cutting edge according to claim 32; wherein the coating material comprises a hard and durable metal such as Cobalt, Carbide and TiN.